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09/360,292	07/22/1999	SUJIT SHARAN	MI22-1106	3962

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18  
EXAMINER

AHMED, SHAMIM

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 06/27/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/360,292

Applicant(s)

SHARAN ET AL.

Examiner

Shamim Ahmed

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 19 March 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 15-24 and 35-41 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 15-24 and 35-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 July 1999 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f):
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 17.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 15-20, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sharan et al (5,747,116) in view of Smith (6,277,733).

Sharan et al disclose a method of forming a contact to a silicon substrate, wherein a contact opening is formed over the silicon substrate and the opening is extending to expose outwardly a silicon containing material (col.3, lines 52-61 and figure 1).

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Sharan et al also disclose that during the above process before depositing any material over the substrate, plasma cleaning is performed to remove unwanted material using hydrogen-containing plasma (col.3, lines 62-67).

Sharan et al do not explicitly teach that applying a masking layer over the substrate forms the contact opening.

However, in a method of making contact opening, Smith teaches that a contact hole or opening is formed by patterning a masking layer of photoresist (col.3, lines 36-45).

It would have been obvious to one skilled in the art at the time of claimed invention to mask the insulation layer (16) of Sharan et al with desired pattern in order to form an opening at a desired position as taught by Smith.

Sharan et al also do not teach that the plasma etching is performed at a temperature of at least 400 degree C.

However, Smith teaches that the temperature of the substrate is maintained around 100-400 degree C during the clean-up process (col.4, lines 32-40).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to combine Smith's teaching into Sharan et al's method for effective removal of the etching residues from the surface of the contact region as taught by Smith.

As to claim 16, Smith teaches the plasma can be an oxygen ash step followed by a clean-up step (col.3, lines 36-38).

As to claims 17-18 and 20, Sharan et al teach that the plasma comprises hydrogen (col.3, lines 64-67).

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As to claim 19, Sharan et al teach that the plasma could comprise  $\text{NH}_3$  (col.5, lines 25-28).

4. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sharan (5,747,116) in view of Smith (6,277,733) as applied to claims 15-20 and 22 above, and further in view of Brown et al (5,780,359).

Modified Sharan et al discussed above in the paragraph 5 but fail to teach the temperature is at least 600 degree C.

However, in a method of removing polymer residue from the surface and sidewalls of a silicon wafer, Brown et al teach that the temperature of the stripping process can be varied from 20 degrees to over 100 degrees C, while the benefits of using higher temperatures includes a rate increase in the chemical portion of the stripping process (col.4, lines 26-33).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to optimize the process temperature to an elevated one because the elevated temperature will increase the rate of reaction of the stripping process as taught by Brown et al.

5. Claims 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sharan et al (5,747,116) in view of Smith (6,277,733) as applied to claims 15-20 and 22 above, and further in view of Stinnett (6,325,861).

Modified Sharan et al discussed above in the paragraph 5 but fail to teach the introduction of at least two plasma etching using different gas chemistries.

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However, Stinnett discloses a method for etching and plasma cleaning of a substrate twice in order to remove unwanted remnant residue from the substrate (col.8, lines 31-40).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Stinnett's teaching into modified Sharan et al's method for efficiently removing the remnant resist material to expose the substrate surface as taught by Stinnett.

By doing so, one could have a better process, wherein the etchant residue and the remnant resist is removed without using a wet cleaning process as taught by Stinnett (col.8, lines 46-49).

6. Claims 35, 38-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sharan et al (5,747,116) in view of Stinnett (6,325,861).

Sharan et al discussed above in the paragraph 5 but fail to disclose the etch residue is carbon containing layer.

However, in a method of making a contact opening through an insulation layer such as silicon dioxide, Stinnett teaches the etch residue includes carbon containing polymer (col.5, lines 13-25).

Therefore, it would have been obvious to have the etch residue is carbon containing polymer because the insulation layer of Sharan et al and the insulation layer of Stinnett are exactly similar and expected to have the same kind of etch residue upon etching the insulation layer to form an opening as taught by Stinnett.

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As to claim 38, Stinnett teaches that the plasma gas comprises oxygen (col.7, lines 52-56).

As to claims 39-40, Sharan et al teach that the plasma comprises hydrogen (col.3, lines 64-67).

As to claim 41, Sharan et al teach that the plasma could comprise  $\text{NH}_3$  (col.5, lines 25-28).

7. Claims 36-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sharan et al (5,747,116) in view of Stinnett (6,325,861) as applied to claims 35, 38-41 above, and further in view of Brown et al (5,780,359).

Modified Sharan et al discussed above in the paragraph 4 but fail to teach the temperature is at least 400 degree and at least 600 degree C.

However, in a method of removing polymer residue from the surface and sidewalls of a silicon wafer, Brown et al teach that the temperature of the stripping process can be varied from 20 degrees to over 100 degrees C, while the benefits of using higher temperatures includes a rate increase in the chemical portion of the stripping process (col.4, lines 26-33).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to optimize the process temperature to an elevated one because the elevated temperature will increase the rate of reaction of the stripping process as taught by Brown et al.

***Response to Arguments***

8. Applicant's arguments filed 3/19/03 have been fully considered but they are not persuasive.

Applicants argue that Sharan et al in view of Smith does not teach an etching process, wherein etching a material beneath a masking layer through an opening and thereby exposing a silicon material at the base of the opening because Smith discloses formation of an opening to expose a metal layer.

This is not persuasive because the primary reference (Sharan et al) teaches that etching a material to form an opening thereby extending the opening to outwardly expose a material comprising silicon or silicon node (14) at the base of the opening (see figure 1).

Examiner states that the secondary reference (Smith) relied upon to show the use of a masking layer such as photoresist in order to form an opening at a desired location by patterning the masking layer (col.3, lines 36-45 and figure 2a).

Therefore, one skilled in the art would have been motivated to use Smith's teach into Sharan et al's process for forming the opening to a desired location by patterning a masking layer as taught by Smith and has nothing to do whether Smith further extends the opening to expose a metal layer or not.

In conclusion, Sharan et al in view of Smith teaches the claimed limitation of forming an opening thereby extending the opening to outwardly expose a material comprising silicon at the base of the opening.



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Applicants also argue that both the secondary references Stinnett and Brown et al do not disclose or suggest the claim 15 recited extending an opening by etching a material beneath a masking layer to expose a material comprising silicon at the base of the opening.

In response, examiner repeated the same statement that the primary reference (Sharan et al) teaches that etching a material to form an opening thereby extending the opening to outwardly expose a material comprising silicon or silicon node (14) at the base of the opening (see figure 1).

Examiner also states that the secondary reference (Stinnett) relied upon to show the use of a masking layer such as photoresist in order to form an opening at a desired location by patterning the masking layer and Brown et al relied upon to show that a stripping process can be varied from 20 degrees to over 100 degree C for increasing the removal rate (see the rejection above).

In addition, in an obviousness rejection the secondary references do not have to show the limitation, which is already taught by the primary reference.

### ***Conclusion***

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (703) 305-1929. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703)-872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Shamim Ahmed  
Examiner  
Art Unit 1765

SA  
June 25, 2003

  
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